



Please write clearly in block capitals.

Centre number

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Candidate number

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Surname

Forename(s)

Candidate signature

I declare this is my own work.

GCSE CHEMISTRY

F

Foundation Tier Paper 2

Time allowed: 1 hour 45 minutes

Materials

For this paper you must have:

- a ruler
- a scientific calculator
- the periodic table (enclosed)

Instructions

- Use black ink or black ball-point pen.
- Pencil should only be used for drawing.
- Fill in the boxes at the top of this page.
- Answer **all** questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- If you need extra space for your answer(s), use the lined pages at the end of this book. Write the question number against your answer(s).
- Do all rough work in this book. Cross through any work you do not want to be marked.
- In all calculations, show clearly how you work out your answer.

Information

- The maximum mark for this paper is 100.
- The marks for questions are shown in brackets.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.

For Examiner's Use

Question	Mark
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
TOTAL	



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0 1

This question is about the Earth's atmosphere.

0 1 . 1

How long ago was the Earth formed?

[1 mark]

Tick (✓) one box.

4.6 billion years ago

☒

4.6 million years ago

☐

4.6 thousand years ago

☐

Table 1 shows the percentages of gases in the atmospheres of Mars and Earth today.

Table 1

Gas	Percentage of gas in atmosphere (%)	
	Mars	Earth
Carbon dioxide	95.97	0.04
Nitrogen	1.89	78.09
Oxygen	0.15	20.95
Other gases	1.99	X

0 1 . 2

Calculate the percentage X of other gases in the Earth's atmosphere.

Use Table 1. $0.04 + 78.09 + 20.95 = 99.08$
 $\therefore \%$ of X = $100 - 99.08$
 $= 0.92\%$

[1 mark]

X = 0.92 %

The atmosphere of the early Earth is thought to have been similar to the atmosphere of Mars today.

The percentages of nitrogen and of oxygen in the Earth's atmosphere today have changed from the percentages in the Earth's early atmosphere.

0 1 3

Draw **one** line from each gas to the change in the percentage of that gas.

Use Table 1.

[2 marks]

Gas	Change in percentage of gas
Nitrogen	Increased by about 4 times
	Increased by about 21%
	Increased by about 40 times
Oxygen	Increased by about 96%

0 1 4

The percentage of carbon dioxide in the Earth's early atmosphere decreased.

Which **two** processes caused this decrease?

[2 marks]

Tick (✓) **two** boxes.

- Carbon dioxide dissolving in sea water (decreases CO_2 in atmosphere) ☒
- Combustion of fossil fuels - (increases CO_2 in atmosphere) ☐
- Farming of animals - causes methane and nitrous oxides (greenhouse gases) ☐
- Formation of sedimentary rocks (decreases the CO_2) ☒
- Volcanoes releasing carbon dioxide (increases CO_2 in atmosphere) ☐

Turn over ►



0 1 . 5

Photosynthesis also decreased the percentage of carbon dioxide in the Earth's early atmosphere.

Photosynthesis increased the percentage of another gas.

Complete the word equation for photosynthesis.

[2 marks]

Carbon dioxide + water → glucose + Oxygen.

0 1 . 6

Complete the sentence.

[1 mark]

Scientists are not certain about the percentages of gases in the Earth's early atmosphere because there is a lack of evidence.

9



0 2

This question is about water.

A student investigated the concentration of salt in sea water.

This is the method used.

1. Filter the sea water to remove sand.
2. Measure the mass of an empty evaporating dish.
3. Measure 50 cm³ of sea water into the evaporating dish.
4. Heat the evaporating dish and sea water.
5. Evaporate the sea water to dryness.
6. Measure the mass of the evaporating dish and salt.

0 2 . 1

What equipment should the student use to measure:

- the mass of the evaporating dish
- the volume of sea water?

[2 marks]

Mass of evaporating dish Mass balance

Volume of sea water Measuring cylinder



0 2 . 2 Table 2 shows the student's results.

Table 2

	Mass in g
Evaporating dish	30.44
Evaporating dish and salt	30.49

The student used 50 cm³ of sea water.

Calculate the mass of salt in 1000 cm³ of this sea water.

[3 marks]

$$\text{Mass of salt} = 30.49 - 30.44$$

$$= 0.05 \text{ g}$$

$$\text{Mass of salt in } 1000 \text{ cm}^3 =$$

$$50 \text{ cm}^3 \rightarrow 0.05 \text{ g of salt}$$

$$1000 \text{ cm}^3 = ?$$

$$\frac{1000 \times 0.05}{50} = \underline{\underline{1.0 \text{ g}}}$$

$$\text{Mass of salt} = \underline{1.0} \text{ g}$$

0 2 . 3 The salt must be completely dry.

Which **two** extra steps are needed to show that the salt is completely dry?

[2 marks]

Tick (✓) **two** boxes.

Filter the sea water again.

☐

Heat the evaporating dish and salt again.

☒

Measure the 50 cm³ of sea water again.

☐

Measure the mass of the empty evaporating dish again.

☐

Measure the mass of the evaporating dish and salt again.

☒

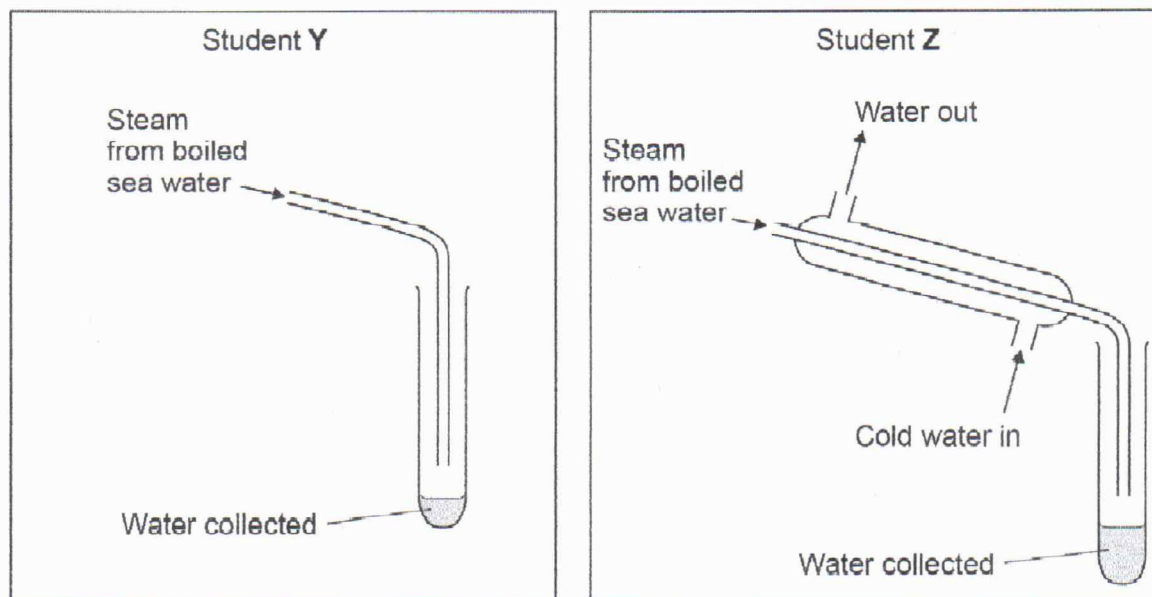
Turn over ►



Two students, Y and Z, distil sea water to collect water.

Figure 1 shows the apparatus used by each student to collect the water.

Figure 1



0 2 . 4 Students Y and Z boil the same volume of sea water for the same period of time.

Explain why student Y collects a smaller volume of water than student Z.

[2 marks]

There is no Condenser in Y thus more steam escapes. Less steam Condenses because cooling is less efficient.

0 2 . 5 Water obtained by distillation does **not** need to be sterilised and is safe to drink.

Suggest why.

[1 mark]

The distilled water is Pure.



Fresh water needs to be sterilised before it is safe to drink.

0 2 . 6

How is fresh water sterilised?

*- Methods used for sterilisation
are Chlorine, ozone and
Ultraviolet light.*

[2 marks]

Tick (✓) **two** boxes.

Using ammonia

☐

*- breaks down stains from animal
fats and Vegetable oils.*

Using chlorine

☒

Using chromatography

☐

- used to separate ink/dyes.

Using filtration

☐

- separates solids from liquids

Using ozone

☒

0 2 . 7

A student tests the pH of fresh water using universal indicator solution.

When added to the fresh water, the colour of the universal indicator solution is green.

What is the pH of this fresh water?

*pH of fresh water
is neutral (pH 7)*

[1 mark]

pH = 7

13

Turn over for the next question

Turn over ►

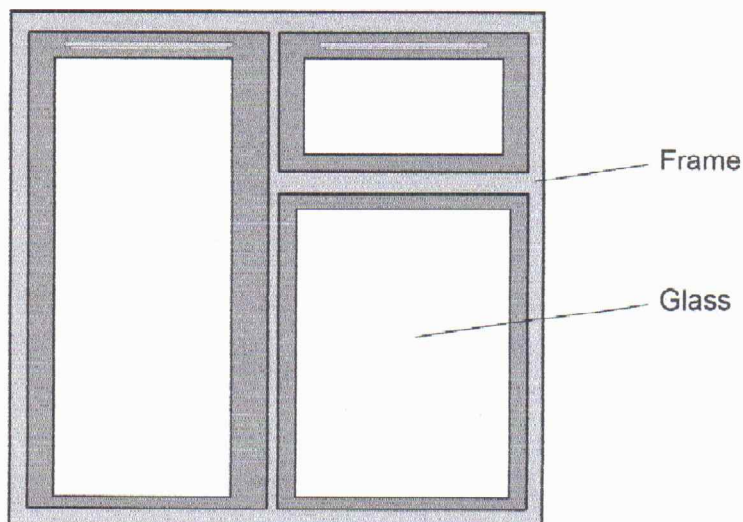


0 3

This question is about substances used to make windows and window frames.

Figure 2 shows a window.

Figure 2



0 3 . 1

Glass is made by heating sand with **two** other materials.

Which **two** other materials are used to make glass?

[2 marks]

Tick (✓) **two** boxes.

Clay

☐

- used in Ceramics.

Graphite

☐

- used as lubricants and as electrodes

Limestone

☒

Sodium carbonate

☒

Sodium hydroxide

☐

used in electrolysis of brine



Window frames need to be:

- easy to install
- resistant to damage.

The polymers poly(chloroethene) and HDPE are used to make window frames.

Table 3 shows information about poly(chloroethene) and HDPE.

Table 3

Property	Poly(chloroethene)	HDPE
Density in g/cm^3	1.4	0.92
Relative strength	72	25

0 3 . 2

Suggest **one** advantage of using poly(chloroethene) compared with HDPE to make window frames.

Give **one** reason for your answer.

Use Table 3.

[2 marks]

Advantage They are stronger compared to Poly-chloroethene.

Reason They are easily damaged, for example plastic pipes are strong and durable.

0 3 . 3

Suggest **one** advantage of using HDPE compared with poly(chloroethene) to make window frames.

Give **one** reason for your answer.

Use Table 3.

[2 marks]

Advantage They have a lower density compared to polychloroethene

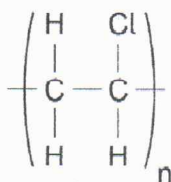
Reason They are light and quite rigid or quite flexible depending on its use.

Turn over ►



0 3 . 4 Figure 3 shows the displayed structural formula of poly(chloroethene).

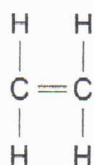
Figure 3



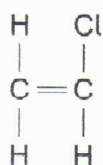
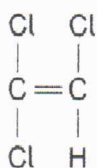
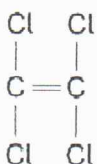
Which monomer is used to make poly(chloroethene)?

[1 mark]

Tick (✓) one box.

☐

ethene

☒☐☐

0 3 . 5

Chlorine gas is used to produce poly(chloroethene).

Describe a test to identify chlorine gas.

Give the result of the test.

[2 marks]

Test Add a damp litmus paper.Result The litmus paper is bleached
or turns white.

0 3 . 6

Wood can be used instead of polymers to make window frames.

- Polymers are unreactive.
- Polymers are produced from crude oil.
- Wood breaks down in wet conditions.
- Wood is produced from trees.

Suggest **one** advantage of using polymers and **one** advantage of using wood to make window frames.

[2 marks]

Advantage of polymers Polymers last for a long
time.Advantage of wood Wood is a renewable
resource.

Question 3 continues on the next page

Turn over ►



Window frames can also be made from an alloy of aluminium.

03.7 6.00 kg of the alloy is used to make a window frame.

Table 4 shows the mass of each element in 6.00 kg of the alloy.

Table 4

Element	Mass in kg
Aluminium	5.94
Magnesium	0.04
Silicon	0.02

Calculate the percentage of aluminium in 6.00 kg of the alloy.

[2 marks]

$$\text{Percentage of Aluminium} = \frac{5.94}{6.00} \times 100\%$$
$$= 99\%$$

Percentage of aluminium = 99 %

03.8 Why is an alloy used instead of pure aluminium to make window frames?

[1 mark]

The alloy is harder than pure aluminium because the contain different sizes, which distorts the regular arrangements of atoms.



0 4

This question is about reactions between gases.

When hydrogen gas is heated with iodine gas, hydrogen iodide gas is produced.

The equation for this reversible reaction is:



This reversible reaction reaches equilibrium in a sealed container.

0 4 . 1

How does the equation show that the reaction is reversible?

[1 mark]



0 4 . 2

Which **two** statements are correct when the reaction reaches equilibrium?

[2 marks]

Tick (✓) **two** boxes.

The forward reaction and reverse reaction are both exothermic.

forward reaction - exothermic

☐

The gases have escaped from the container.

☐

The hydrogen no longer reacts with iodine.

☐

The mass of each substance does not change.

☒

The rates of the forward reaction and reverse reaction are equal.

☒

- The reactants or products escape (open system)
- Concentration of reactants and product do not change
- backward reaction is endothermic



0 4 . 3

The initial mixture of hydrogen and iodine in the sealed container is purple.

Hydrogen iodide is colourless.

How will the colour of the mixture in the sealed container have changed when equilibrium is reached?

[1 mark]

Tick (✓) one box.

Iodine vapour is deep purple colour

The mixture will have become a deeper purple.

☐

The mixture will have become a paler purple.

☒

The mixture will have become colourless.

☐

0 4 . 4

The rate of reaction between gases is affected by changing the pressure.

Complete the sentences.

[3 marks]

When the pressure of the reacting gases is increased,

the rate of reaction Increases

This is because at higher pressures the distance

between the particles decreases

This means that the frequency of collisions Increases

0 4 . 5

Give one other way of changing the rate of reaction between gases.

You should not refer to pressure in your answer.

[1 mark]

- By changing the temperature.
- Addition of a catalyst in the reaction.



0 5

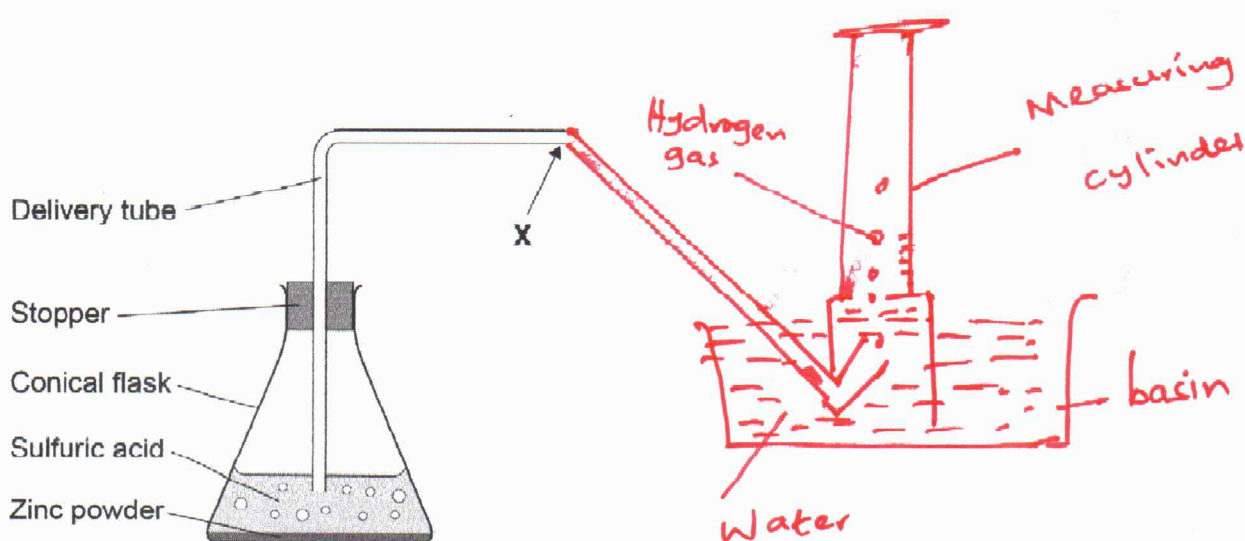
A student investigated the rate of the reaction between zinc and sulfuric acid.

This is the method used.

1. Pour 40 cm^3 of sulfuric acid into a conical flask.
2. Add 2.0 g of zinc powder to the conical flask.
3. Put the stopper in the conical flask.
4. Measure the volume of hydrogen gas collected every 30 seconds for 5 minutes.

Figure 4 shows part of the apparatus used.

Figure 4



0 5 . 1

X shows where a piece of equipment is connected to measure the volume of hydrogen gas collected.

Complete **Figure 4** to show the equipment used.

[1 mark]

0 5 . 2

The student made an error setting up the delivery tube shown in **Figure 4**.

Describe the error **and** the problem this error would cause.

[2 marks]

Error made

The delivery tube is in sulfuric acid.

Problem caused

The sulfuric acid will travel up the tube and no gas will be collected.

Question 5 continues on the next page

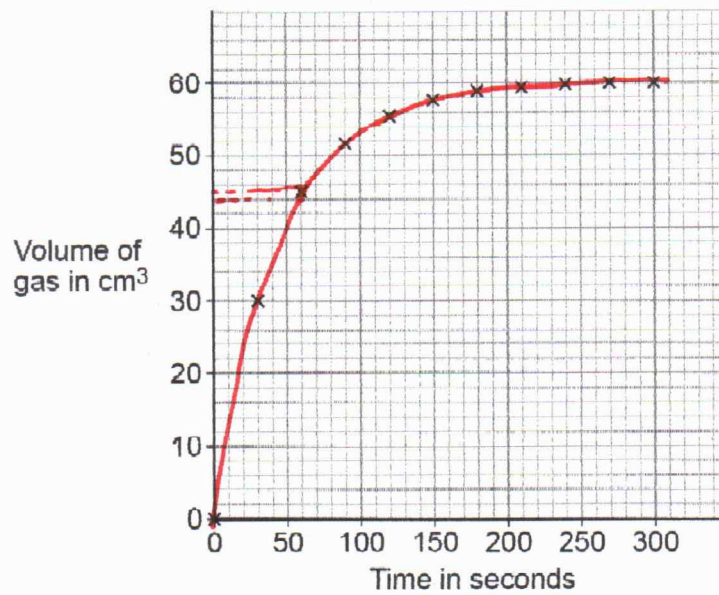
Turn over ►



The student then set up the apparatus correctly.

Figure 5 shows the student's results.

Figure 5



0 5 . 3 Complete Figure 5 by drawing a line of best fit.

[1 mark]



0 5 . 4

Determine the mean rate of reaction between 0 seconds and 60 seconds.

Use the equation:

$$\text{mean rate of reaction} = \frac{\text{volume of gas formed}}{\text{time taken}}$$

Use data from Figure 5.

Give the unit.

Choose the answer from the box.

[4 marks]

cm^3/s	g/s	s/cm^3	s/g
------------------------	--------------	-----------------	--------------

Volume of gas at 60 seconds = 45 cm^3 .

Rate of reaction = $\frac{45 \text{ cm}^3}{60}$

Time = $60 - 0$

= 60 seconds

= $0.75 \text{ cm}^3/\text{s}$

Mean rate of reaction = 0.75 Unit cm^3/s

0 5 . 5

The student repeated the investigation using sulfuric acid of a higher concentration.

The student plotted the results and drew a line of best fit.

How would the line of best fit for higher concentration compare with the line of best fit for lower concentration?

[1 mark]

Tick (✓) one box.

The line of best fit for higher concentration would have a less steep slope.

☐

The line of best fit for higher concentration would have a steeper slope.

☒

The lines of best fit would have slopes with the same steepness.

☐

9

Turn over ►



0 6

Potash alum is a chemical compound..

Potash alum contains potassium ions, aluminium ions and sulfate ions.

0 6 . 1

Which **two** methods can be used to identify the presence of potassium ions in potash alum solution?

[2 marks]

Tick (✓) **two** boxes.

Flame emission spectroscopy

☒

Flame test

☒

Measuring boiling point of solution

☐*- Test for physical of water.*

Paper chromatography

☐*- separates dyes from inks. etc*

Using litmus paper

☐*- Test whether substance is acid or base.*

0 6 . 2

Sodium hydroxide solution is used to test for some metal ions.

Sodium hydroxide solution is added to a solution of potash alum until a precipitate forms.

Complete the sentence.

Choose the answer from the box.

[1 mark]

blue

brown

green

white

The colour of the precipitate formed is

white

0 6 . 3

Complete the sentence.

Choose the answer from the box.

[1 mark]

barium chloride solution

limewater

red litmus paper

silver nitrate solution

Sulfate ions can be identified using dilute hydrochloric acid

and barium chloride

0 6 . 4

A solution of potash alum has a concentration of 258 g/dm^3 Calculate the mass of potash alum needed to make 800 cm^3 of a solution of potash alum with a concentration of 258 g/dm^3

Give your answer to 3 significant figures.

[4 marks]

Convert 800 cm^3 to dm^3 $1 \text{ dm}^3 = 1000 \text{ cm}^3$ $800 = 800 \text{ cm}^3$

$$\frac{800}{1000} = \underline{\underline{0.8 \text{ dm}^3}}$$

$$\text{Mass} = 0.8 \times 258 \text{ g}$$

$$= 206.4 \text{ g}$$

$$\approx \underline{\underline{206 \text{ g}}}$$

Mass (3 significant figures) = 206 g

8

Turn over ►



07

This question is about organic compounds.

07.1

Butane is an alkane with small molecules.

Complete the sentence.

Choose the answer from the box.

[1 mark]

fertiliser

formulation

fuel

Butane can be used as a

fuel.

07.2

Poly(propene) is a polymer.

What is the name of the monomer used to produce poly(propene)?

[1 mark]

Tick (✓) one box.

Propane

☐It is alkane but monomers
are for alkenes.

Propanoic acid

☐

It is a carboxylic acid

Propanol

☐It is an alcohol and not
involved in polymers.

Propene

☒

Ethene and steam react to produce ethanol.

The equation for the reversible reaction is:



0 7 . 3

The reaction produces a maximum theoretical mass of 400 kg of ethanol from 243 kg of ethene and 157 kg of steam.

A company produces 380 kg of ethanol from 243 kg of ethene and 157 kg of steam.

The percentage yield of ethanol is less than 100%

Calculate the percentage yield of ethanol.

Use the equation:

$$\text{percentage yield of ethanol} = \frac{\text{mass of ethanol actually made}}{\text{maximum theoretical mass of ethanol}} \times 100$$

$$\text{Percentage yield} = \frac{380}{400} \times 100\%$$

$$= 95\%$$

[2 marks]

Percentage yield = 95 %

0 7 . 4

What are **two** possible reasons why the percentage yield of ethanol is less than 100%?

[2 marks]

Tick (✓) **two** boxes.

Ethanol is the only product of the reaction.

☐

Ethanol is very unreactive.

☐

Some ethanol changes back into ethene and steam.

☒

Some ethanol escapes from the apparatus.

☒

Some ethanol reacts with steam.

☐

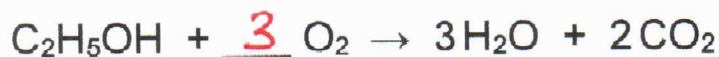
Turn over ►



0 7 . 5 Ethanol burns in oxygen.

Balance the equation for the reaction.

[1 mark]



0 7 . 6 Two processes for producing ethanol are:

- fermentation
- hydration (reacting ethene with steam).

Table 5 shows information about the processes.

Table 5

Feature	Process	
	Fermentation	Hydration
Raw material	sugar	crude oil
Energy usage	low	high
Rate of reaction	slow	fast
Purity of ethanol	15%	98%

Give **two** advantages and **two** disadvantages of using fermentation to produce ethanol.

[4 marks]

Advantage of fermentation 1 It is Produced from renewable resource eg. sugar cane.

Advantage of fermentation 2 The energy usage is low compared to hydration.

Disadvantage of fermentation 1 The ethanol Produced is impure.

Disadvantage of fermentation 2 There is a slow rate of reaction.



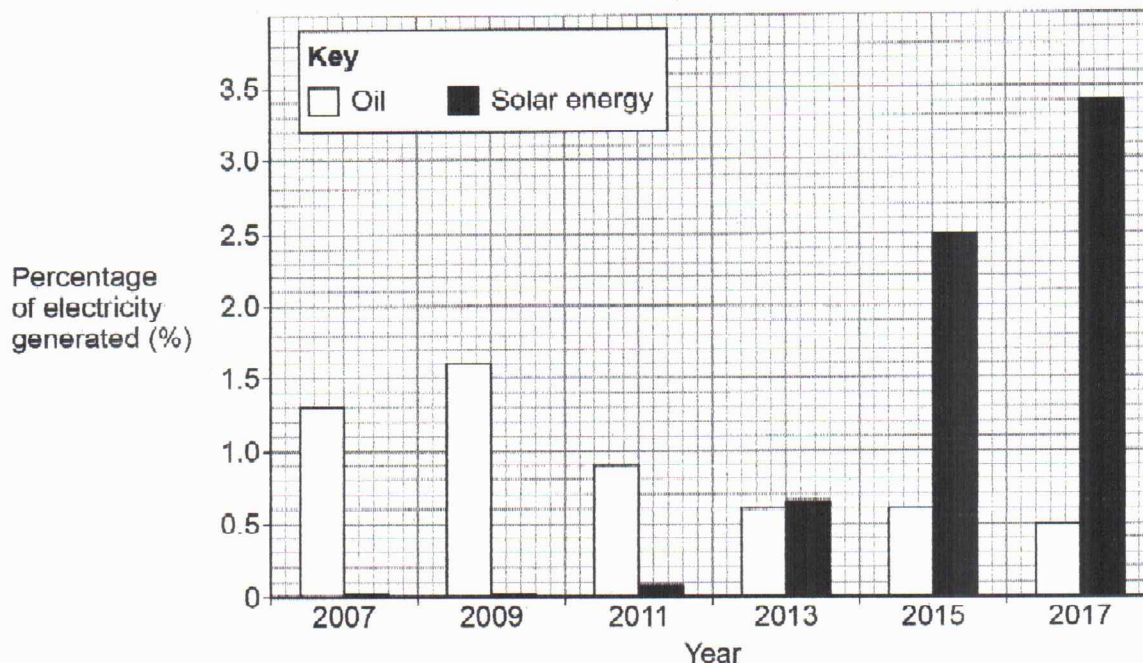
0 8

This question is about fuels and energy.

Figure 6 shows the percentage of electricity generated in the UK between 2007 and 2017 using:

- oil
- solar energy.

Figure 6



0 8 1

Describe the changes in the percentage of electricity generated in the UK between 2007 and 2017 using:

- oil
- solar energy.

Use data from Figure 6 in your answer.

[3 marks]

The use of oil has decreased from 1.3% to 0.5%. The use of solar energy has increased by 3.4%, which increased from 0% to 3.4%. Between 2013 and 2015 no change in oil use.

Turn over ►



08.2

Oil contains carbon and some sulfur.

When oil is burned, the products of combustion may be released into the atmosphere.

Explain the environmental effects of releasing these products of combustion into the atmosphere.

[6 marks]

The Carbon dioxide Produced is a green house gas therefore surface temperature increases which results in global warming. When levels of Carbon dioxide rises it results in climate change which leads to the polar ice caps melt which increases sea levels and enhances flooding. The extreme weather events is affected which reduces the biodiversity.

Sulfur dioxide is produced and causes acid rain that damage buildings / statues. It also impacts trees and damage the ecosystem of aquatic animals. Sulfur dioxide leads to respiratory problems in humans such as asthma.



0 8 3

Suggest **one** reason why using solar energy is a more sustainable way of generating electricity than burning oil.

[1 mark]

Solar is a renewable source of energy
while oil is a finite resource.

0 8 4

Solar energy may **not** be able to replace the generation of electricity from fossil fuels completely.

Suggest **two** reasons why.

[2 marks]

- 1 The amount of sunshine is unreliable,
due to different weather patterns.
- 2 There has been increased demand for
more energy.

12

Turn over for the next question

Turn over ►



0 9

This question is about alkanes.

Table 6 shows information about some alkanes.

Table 6

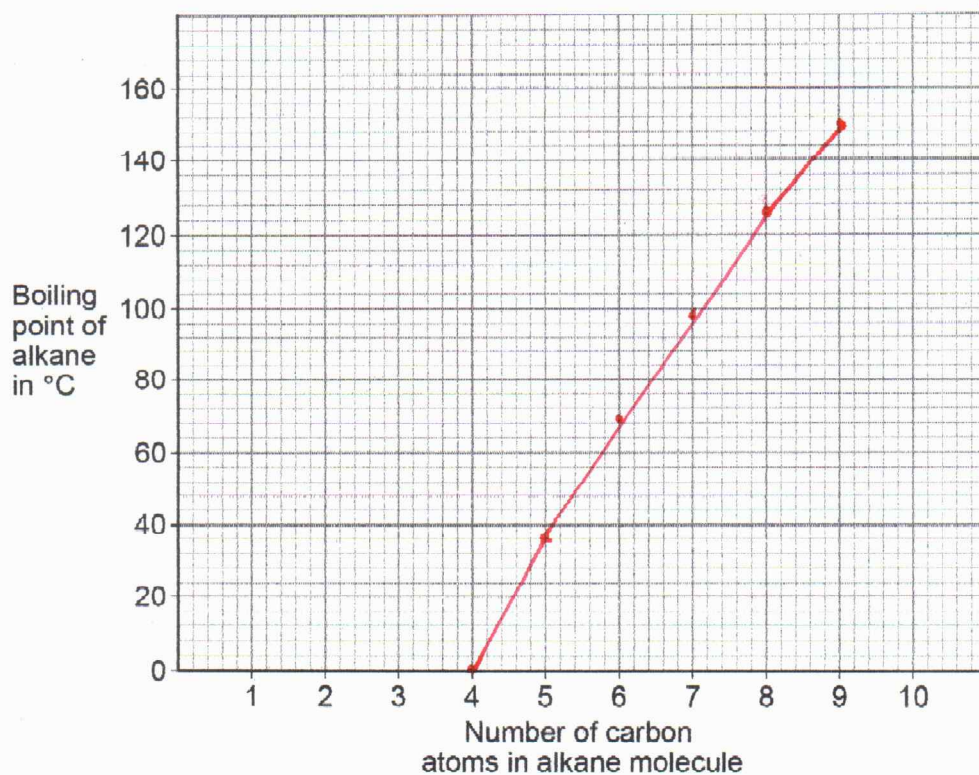
Number of carbon atoms in alkane molecule	Boiling point of alkane in °C
4	0
5	36
6	69
7	X
8	126
9	151

0 9 . 1

Plot the data from Table 6 on Figure 7.

[2 marks]

Figure 7



09.2

Predict the boiling point X of the alkane with seven carbon atoms in a molecule.

Use Table 6 and Figure 7.

[1 mark]

X = 97 °C

09.3

Figure 7 is not suitable to show the boiling point of the alkane with three carbon atoms in a molecule.

Suggest one reason why.

[1 mark]

The boiling point is lower than 0°C.

09.4

What is the state at 20 °C of the alkane with four carbon atoms in a molecule?

Use Table 6.

[1 mark]

gas.

Question 9 continues on the next page

Turn over ►



Table 6 is repeated below.

Table 6

Number of carbon atoms in alkane molecule	Boiling point of alkane in °C
4	0
5	36
6	69
7	X
8	126
9	151

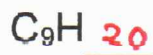
The alkane with nine carbon atoms in a molecule is called nonane.

0 9 . 5

Complete the formula of nonane.



[1 mark]



0 9 . 6

Nonane will condense lower in a fractionating column during fractional distillation than the other alkanes in Table 6.

Explain why.

You should refer to the temperature gradient in the fractionating column.

[2 marks]

Nonane has a higher boiling point so
nonane Condenses where the column
has a higher temperature.



1 0

This question is about paper chromatography.

A food colouring contains a dye.

1 0 . 1

Plan an investigation to determine the R_f value for the dye in this food colouring.

$$R_f = \frac{\text{distance moved by substance}}{\text{distance moved by solvent}}$$

Your plan should include the use of:

- a beaker
- a solvent
- chromatography paper.

[6 marks]

You are required to draw a line using a pencil at the bottom of the chromatography paper (baseline). Place spots of food colouring. Use a suitable solvent. The solvent depends on what's being tested. Some compounds dissolve well in water. Place the chromatography paper in a beaker, and dissolve it in solvent. The solvent is below start line. Use a lid on top of the container (beaker) to stop the solvent evaporating. Wait for solvent to travel up the paper until near top. Mark the solvent front and dry the chromatography paper. Measure distance between start line and centre of spot, then measure distance between start line and solvent front. Then obtain the R_f value.



1 0 . 2

Two students investigated a dye in a food colouring using paper chromatography.

Each student did the investigation differently.

The R_f values they determined for the **same** dye were different.

How did the students' investigations differ?

[1 mark]

Tick (✓) **one** box.

Different length of paper used

☐

- The length of paper
should be same.

Different period of time used

☐

- length of time should
be equal.

Different size of beaker used

☐

- use same sizes of
beakers.

Different solvent used

☒

1 0 . 3

Paper chromatography involves a stationary phase.

What is the stationary phase in paper chromatography?

[1 mark]

Tick (✓) **one** box.

Beaker

☐

Dye

☐

Paper

☒

Solvent

☐

- mobile phase.

Stationary phase is a strip or piece of
paper in the solvent.

END OF QUESTIONS

